Community Oriented Wolf Strategy

Year 1 Progress Report

June 2003 - August 2004

by

Oldman Basin Carnivore Advisory Group

with compilation by:
Carita Bergman, Area Biologist, Pincher Creek, Fish and Wildlife Division, SRD
Terry Mack, Problem Wildlife Specialist, Claresholm, Fish and Wildlife Division, SRD

We, the non-governmental members of the Oldman Basin Carnivore Advisory Group, have reviewed the Community Oriented Wolf Strategy Year 1 progress report, and have found that it is a satisfactory representation of historical information we have considered as necessary context in our decision-making and recommendations, and of recent progress in wolf management in Southwest Alberta (undersigned):

ORIGINAL SIGNED BY ALL MEMBERS

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Ron Davis (Ranchlands M.D.)

_____

Harvey Gardner (Federation of Alberta Naturalists)

_____

Julia Gerwein (local rancher)

_____

Gordon Hoffman (Alberta Trappers Association)

_____

Charles Mamo (Southern Alberta Conservation Cooperative)

_____

Jim Pissot (Defenders of Wildlife Canada)

_____

Hugh Lynch-Staunton (Alberta Beef Producers)

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Executive Summary

Wolf management in southwest (SW) Alberta has been characterized mainly by reaction to livestock-wolf conflicts through non-specific removal of wolves in localized problem areas. As such, government managers have not been able to achieve the goals outlined in the 1991 provincial management plan: primarily the establishment of a "permanent, unmanipulated" population in forests adjacent to Waterton Lakes National Park; wolf inventory; improved connectivity with the Montana population; and better management of livestock depredation.

In spring 2003, significant funds were designated for the first time by the Alberta Fish and Wildlife Division (F&W), specifically for wolf management in Southwest Alberta. Additionally, Alberta Beef Producers, Defenders of Wildlife Canada, Community Development, and several individuals provided significant funding or in kind support. Management response began with the establishment of a multi-stakeholder advisory Group, composed of representatives from the Federation of Alberta Naturalists, Alberta Beef Producers, Alberta Trappers Association, local municipal districts, local ranching enterprises, Defenders of Wildlife Canada, and the Southern Alberta Conservation Cooperative (SACC). In addition, participation included government representatives from Sustainable Resource Development (Fish and Wildlife Division and Rangelands Management) and Community Development. Regular meetings of this group provided advice on direction of local wolf management actions, with a particular focus on addressing livestock-wolf conflict.

Over the course of a year, eleven wolves in three separate wolf packs were captured and released with satellite or Very High Frequency (VHF) radio collars. Key to this success was collaboration with local trappers, SACC, and the use of helicopters to perform aerial net capture (a technique never attempted previously in southwest Alberta). This accomplishment has resulted in a number of benefits for local wolf management, never before achieved:

- Large gains in biological information: minimum pack size, reproduction and survival information, location of den sites, travel routes and territory boundaries.
- Identification of neighbouring uncollared packs through concurrent sightings, depredation, tracks, public reports; ultimate establishment of population status.
- Minimum population estimate of wolves in SW Alberta.
- Timely information on wolf activity provided to ranchers to assist in proactive response to cattle depredation, and the provision of radio receivers cooperating ranchers enabling them to monitor wolf presence.
- Characterization of depredation dynamics and identification of specific wolves involved in depredation.
- Ability to target specific packs or individual wolves effectively and in a timely and humane fashion, when control is deemed necessary.
- Ability to deploy backup collars when needed, to maintain our tracking ability of wolf packs, and ability of problem wildlife staff to effectively address depredation.
- Establishment of solid knowledge as basis for effective communication (to Advisory Group, ranchers, public, funders, etc.).

- Communication and collaboration among a wide range of interests in the region.

It should be emphasized that perhaps the largest barrier to maintaining a stable wolf population in southwest Alberta is conflict between wolves and livestock producers. In past years, ranchers have been dubious about releasing collared wolves as opposed to simply killing them, in areas where conflicts were prevalent. This has hindered the gathering of crucial biological information, and retarded the development of a local strategy. By working together with multiple stakeholders and achieving similar levels of understanding, we have achieved increased support for the capture and release of collared wolves in areas where conflicts occur.

At the same time, we have used aerial net capture both for collaring wolves, and in some cases for capturing wolves for euthanasia when conflicts were considered chronic. This has allowed us to collect significant biological data, and provided a tool that is efficient, selective and humane when wolf control is warranted (in contrast to the previous use of poison), and as cost effective as ground efforts when staff salary and overtime are accounted for.

For the first time, we have been able to achieve a science-based estimate of wolf survival and mortality in southwest Alberta. The determination of survival is crucial if we are to ensure a sustained wolf population in the future. Scientific literature indicates that winter mortality should be no greater than 40% if population numbers are to be sustained. Data from 11 collared wolves indicate a *winter* mortality rate of 34% (56% annual mortality). An estimate of *winter* mortality from estimated population size and known deaths and dispersal is 20%. This is likely an underestimate because of unreported deaths, but still of similar magnitude to the former estimate.

Emphasis now needs to be placed on maintaining and monitoring multiple collared wolves in as many packs as feasible, generating repeated estimates of annual mortality to allow examination of annual variation in survival, honing a consistent and repeatable strategy for dealing with livestock-wolf conflict and continuing a productive conversation among stakeholders. Success in the first year has been good, but will only continue as the needs of stakeholders are met, and as budgets permit.

Report Goals:

1) Summarize recent history of wolf population and issues

2) Characterize the nature of livestock depredation[1] in SW Alberta

3) Trace the recent evolution of management practices

4) Update knowledge of wolf status in SW Alberta

5) Establish knowledge base for future public communication and funding requests

I. Introduction to wolf management in SW Alberta

In association with large ungulate populations, wolves once ranged throughout western Canada, including the Great Plains of Alberta and Saskatchewan. As settlement spread and predators were removed to prevent conflicts with agriculture, wolf range retracted to mountainous and forested habitats. A rabies outbreak in coyotes and foxes in 1952 resulted in a massive carnivore population control program by the Government of Alberta (1952-1966) that negatively impacted numbers of numerous carnivore species. When this control program ceased, wolf populations once more began to expand into previously occupied habitat, with reoccupation beginning in southwest Alberta as wolves continued to push southward in the 1970's and 1980's (although note that local anecdotal knowledge is that wolves have consistently been present/travelling through the area throughout the century).

The 1991 Management Plan for Wolves in Alberta (MPWA; Alberta Fish and Wildlife Division 1991; pp. 66, 73;) classified southern wolf populations as "few or sporadic." This is reflected in the current government website (http://www3.gov.ab.ca/srd/fw/wolves/status.html), where the current status of the wolf in southwest Alberta is classified as "sporadic," in contrast to "permanent" populations inhabiting regions from Kananaskis Country to the north. This classification was in large part based on a study conducted in the early 1980's that failed to catch any wolves in 2171 trap-nights (number of traps multiplied by the number of nights trapping occurred), balanced with a few concurrent observations and wolf harvests during that time (Alberta Fish and Wildlife Division 1991; p. 30). It should be noted that the 1991 provincial wolf

[1] "Depredation" is locally used to refer to the process of wild carnivores preying on domestic livestock, in contrast to "predation" which is defined as carnivores preying on wild animals.

management plan guides current Fish and Wildlife Division management actions, though it has not been formally adopted by the province.

In 1993-1994, a second attempt was made to capture wolves in SW Alberta, with the intent of gaining a better understanding of wolf numbers, range, reproduction, and mortality rates. In collaboration with university researchers, US Fish and Wildlife Service and Waterton Lakes National Park staff, three collared wolves that had migrated to Canada from the United States, in addition to a fourth wolf captured and released in the Belly River area, were tracked and monitored. Unfortunately, a combination of public misinformation and an increase in livestock depredations contributed to rising anti-wolf sentiment amongst a sector of the public, and an unusually large harvest of wolves that included the study animals caused the study to be terminated the following year (Richard Quinlan, personal communication).

From 1999 to present, the Southern Alberta Conservation Cooperative (SACC, an independent wolf research group) captured 3 wolves south of the Bow River that were monitored sporadically, in addition to conducting landowner surveys regarding livestock management practices in relation to carnivore depredation. No other data have been collected that allow definition of the population status of wolves in this area, and many assumptions are implicit in knowledge of current wolf status in the area.

With the exception of Waterton Lakes National Park and higher elevation rocky terrain, virtually all territory available to wolves is grazed by livestock. Wolves in this area are trapped in season, hunted September through May, and taken by ranchers on and within 8 km of private ranch lands any time of the year. There are no established bag limits. Mandatory reporting on wolf harvest in the study area was introduced in 2000, but compliance is difficult to monitor. The majority of wolves taken in southwest Alberta are through trapping (Fish and Wildlife Division unpublished data).

Ungulate populations in southwest Alberta have almost without exception shown increases over the past decade and a half, providing a strong natural prey base for the wolf population. For example, elk - a preferred prey for wolves - have increased from 2500 in the early 1980's to well over 3500 in 1998, with growth continuing to present time. Interestingly, this is the same time period corresponding to the re-establishment of wolves in southwest Alberta.

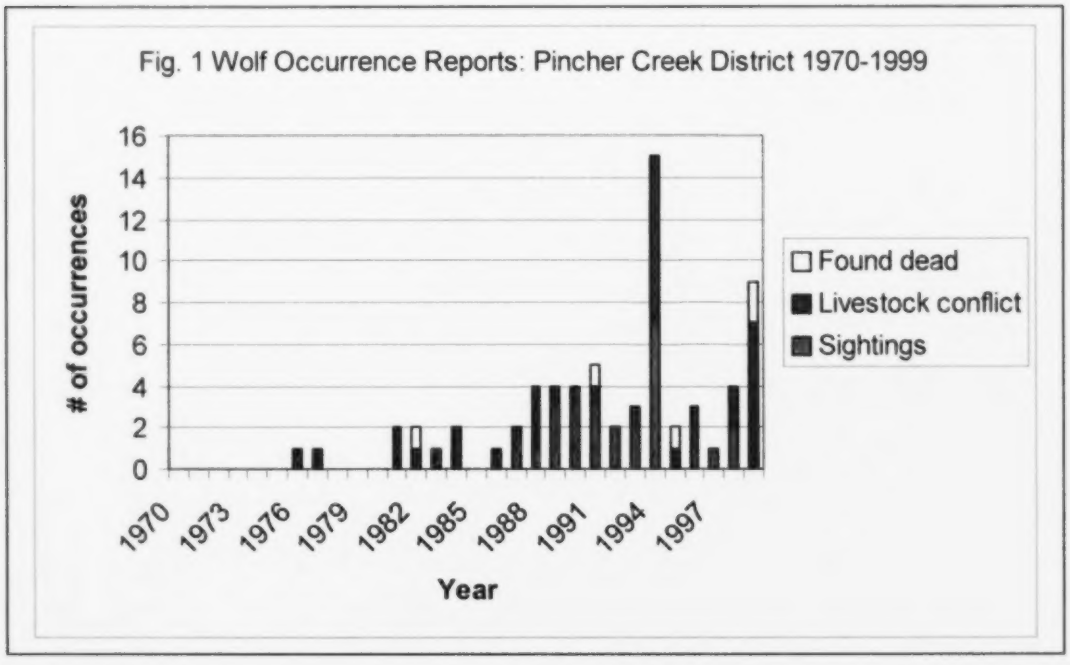
The management area under discussion incorporates wildlife management units 300, 302, 303, 304, 305, 306, 308, 310 (partial) 400 and 402. This area is roughly defined by the international border on the south, BC border on the west, Highway 2 on the east, and the Highwood River-Pekisko drainages to the north.

II. History of wolf occurrences and conflict response: 1970-1999

As wolf packs began to reoccupy territories in SW Alberta during the 1970's and 1980's, wolf occurrence reports gradually became more common. A search of Fish and Wildlife Division (F&W) enforcement occurrence records (all reports of wildlife made by the public to F&W) for the Pincher Creek enforcement district (1970-1999) showed no occurrences linked to wolves from 1970-1975 (Figure 1). In the following five years (1976-1980), two complaints (both regarding livestock depredation by wolves) were reported, although not confirmed. From 1981-1985, occurrences averaged one per year

(including sightings, livestock conflicts and wolves found dead), increasing to an average of three occurrences/year in 1986-1990, and five occurrences/year in 1991-1995 (Figure 1).

Management response to livestock depredation or harassment in SW Alberta in the early period of recolonization by wolves (1980's and early 1990's) usually consisted of an investigation by F&W officers to confirm whether wolves were involved in the conflict, followed by advice to the landowners to shoot wolves that they considered a problem. On occasion, ungulate carcasses were used as bait to attract wolves in areas of depredation, so that the chance of success of shooting wolves was increased. More recently, officers have advised landowners to contact local trapping experts to remove problem wolves, and this has resulted in a few wolves successfully removed from problem areas (Perry Abramenko, personal communication). In some SW Alberta enforcement districts where conflicts were considered chronic or unbearable, strychnine was used to reduce wolf numbers in the following pack territories (as currently defined later in report) in six winters:1987-1988 (Bob Creek one killed; 1989-1990 (Willow Creek three killed – whole pack), 1992-1993 (Bob Creek one killed), 1994-1995 (Bob Creek four killed), and 2002 (Bob Creek none killed) (Kirk Olchowy, personal communication and F&W Division files). In some cases, the use of poison has resulted in significant negative media attention.



It should be noted that all use of toxicants since wolf reoccupation in the study area has been focussed on the area around the Bob Creek Wildland and Willow Creek. In years following the successful use of strychnine, the frequency of livestock depredations decreased (Southern Alberta Conservation Cooperative 2001).

Compensation for livestock kills by wolves was introduced in 1974. While the rate of compensation has varied over the years, current compensation is 100% of

commercial meat value, with compensation for treatment of injured stock also in place. The program was discontinued for a period of 3 years between 1993 and 1996, leading to lower tolerance by livestock producers to wolves and to wolf depredation. The program now has two kill classifications. Those that the investigating officer can confirm as a predator kill are paid at 100% of the market value (on the day it was killed) for that class of animal (e.g bred heifer vs. slaughter heifer). The second classification covers the circumstance in which there is limited evidence leading to the conclusion that depredation was the probable cause. If so, and there has been a confirmed kill within a 90 day period and within a 10 km radius of the suspected kill, the program pays a rate of 50% of the market value. The program also pays for medical treatment of injured animals likely to recover, up to the value of the animal. From a ranching perspective, livestock producers indicate that they are generally unhappy with the compensation program, even at 100%, since they feel that many of the other costs associated with depredation are never covered (C. Mamo, personal communication; see discussion below for details).

Recent history of wolf depredation in Pincher Creek wildlife management area

The dynamics of the wolf population apparent in SW Alberta is one of increasing wolf numbers, followed by increasing livestock conflicts, followed by reduction of wolf numbers through increased hunting and trapping pressure and provincial management actions. Such cycles are undesirable by both the ranching community, and from a biological perspective. Recent conflict areas and a brief description of the management actions that followed are below:

1) Front Range south of Highway 3 (WMU 300, 302, 400): livestock conflicts (both kills, injuries and harassment reports) were high in 1999 (seven), and continued to be high in 2000 (five) and 2001 (14) (Fig. 1). In 2002, eight conflicts occurred. Local hunting and trapping efforts that targeted what was believed to be the responsible pack resulted in a significant reduction in the resident pack (Anonymous, personal communication), with six wolves being registered as legally harvested in this area between June 2001 and June 2002 (for a summary of regulations defining the modes and limits of legal harvest, see Appendix 1). For 2003/2004, conflicts have been low, and occasional wolf sightings reported.

2) Bob Creek Area (WMU's 304, 305, 308): confirmed losses or injuries of cattle due to wolves numbered 21 in 1999, four in 2000, 11 in 2001, and 11 in 2002. According to legal hunting and trapping registrations, 12 wolves were harvested from the area between November 2001 and May 2002, and F&W staff utilized toxicants in a localized area on private land in an effort to reduce wolf numbers in this area in the spring of 2002. No wolves were removed as a result of this control action. Depredations declined to only two in the summer of 2003. In the fall of 2003, two sightings of wolves were reported by hunters in the south Porcupine Hills (three and five wolves, respectively, all gray in colour). In the spring of 2004, depredation once again increased following introduction of cattle to allotments for a spring grazing period (see detail below).

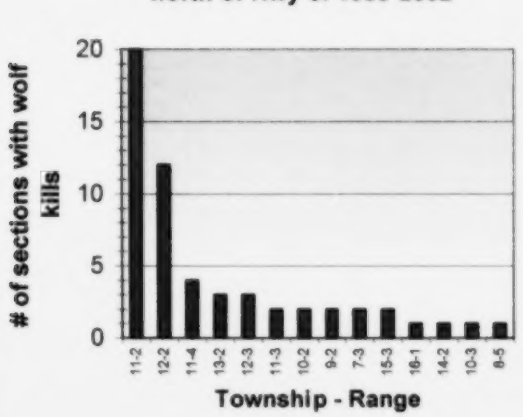
3) Willow Creek (WMU 310): depredation had been occurring for a number of years (Terry Mack, unpublished data 2001-5, 2002-3, 2003-25), with significant losses

beginning in the early summer of 2003. Attempts were made to reduce the pack in a stepped fashion in hopes of reducing depredation, with the removal of four wolves through the fall months, followed by another four in January 2004, and two more in March 2004, leaving only four wolves on the territory. Depredation has ceased since that time. Although this area lies outside of the Pincher Creek management area, it is included here because of its similarity to problems further south. Further detail follows in this document.

4) Dutch Creek, Racehorse Creek, South Livingstone 2003 (WMU's 303, 306, 402): numbers of livestock for which compensation was paid in 2003 included 13 cattle killed or injured and destroyed, and one individual that recovered from injury (it should be noted that the same statistics tallied from four years of enforcement database records, 1999-2003, showed many fewer conflicts). A male wolf was shot by a hunter in this area in fall 2003, from a pack of 14 gray-coloured wolves. Because of the significant vocal reaction of the pack in addition to their following the hunter for an extended distance after the kill, it is quite likely that the dead wolf was the dominant male. The collar of a second wolf that apparently had been shot was discovered in October 2004, and a third wolf was shot by a rancher SE of The Gap, January 2004, while it was harassing cattle.

An examination of wolf depredations north of Highway 3 (Bob Creek and Dutch Creek -- Livingstone areas) demonstrates that livestock conflicts are generally clustered. Over the four years 1999-2002, 45 cattle were killed by wolves, and an additional 22 cattle injured or destroyed because of injuries caused by wolves. Average annual cattle kills by wolves was 11.5, and average annual injury was 5.5. In this area, there are roughly 45 townships; in these townships, 14 have experienced wolf kills over the 4-year period in question, and the other 31 have not. Of the 14 townships experiencing depredation, 12 had four or less depredations, while the two remaining had 12 and 20 kills, respectively (Figure 2).

Figure 2. Distribution of wolf kills north of Hwy 3: 1999-2002



From a monthly perspective through the year, cattle depredation by wolves peaks in August and September (Figure 3 – kills only). Average monthly depredation peaked in August at roughly three cattle/month, followed by two in September, and roughly one each month the rest of the year (Figure 4 – kills only).

Fig. 3 Wolf cattle depredations: 1999-2002

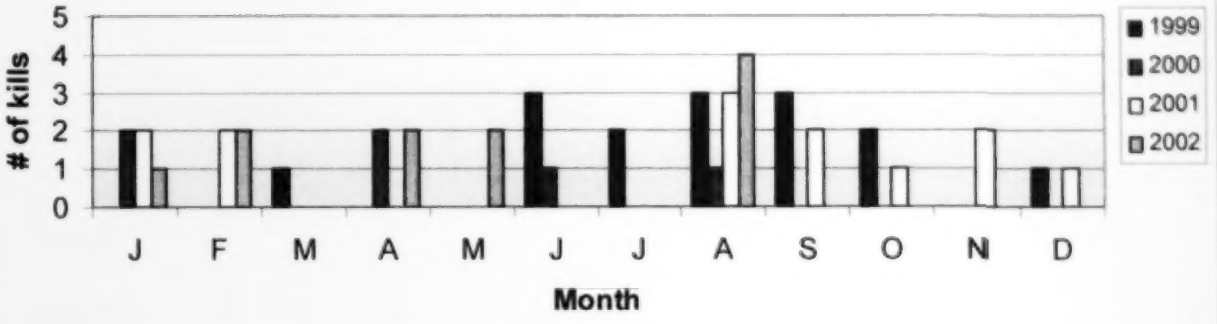
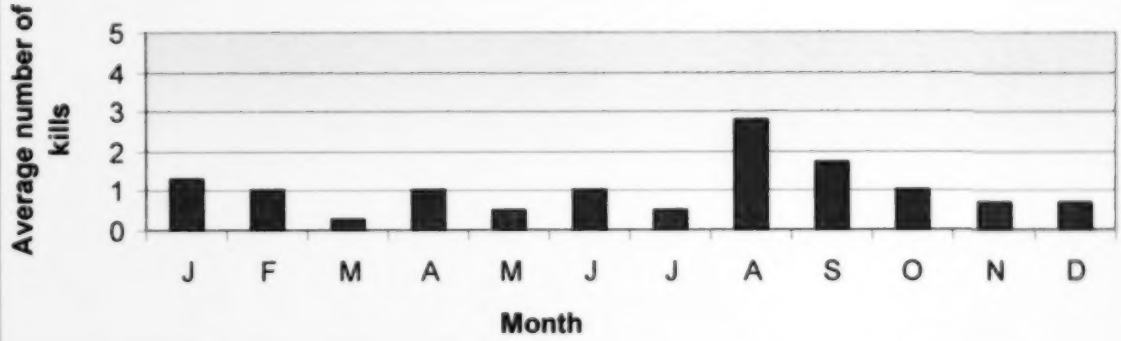


Fig. 4 Average monthly wolf depredations: 1999-2002



When examined spatially, the townships that receive the greatest depredation (kills and injuries, combined) are clustered in the area of the Bob Creek Wildland, east of the Livingstone Range, and west of the Porcupine Hills (Figure 5):

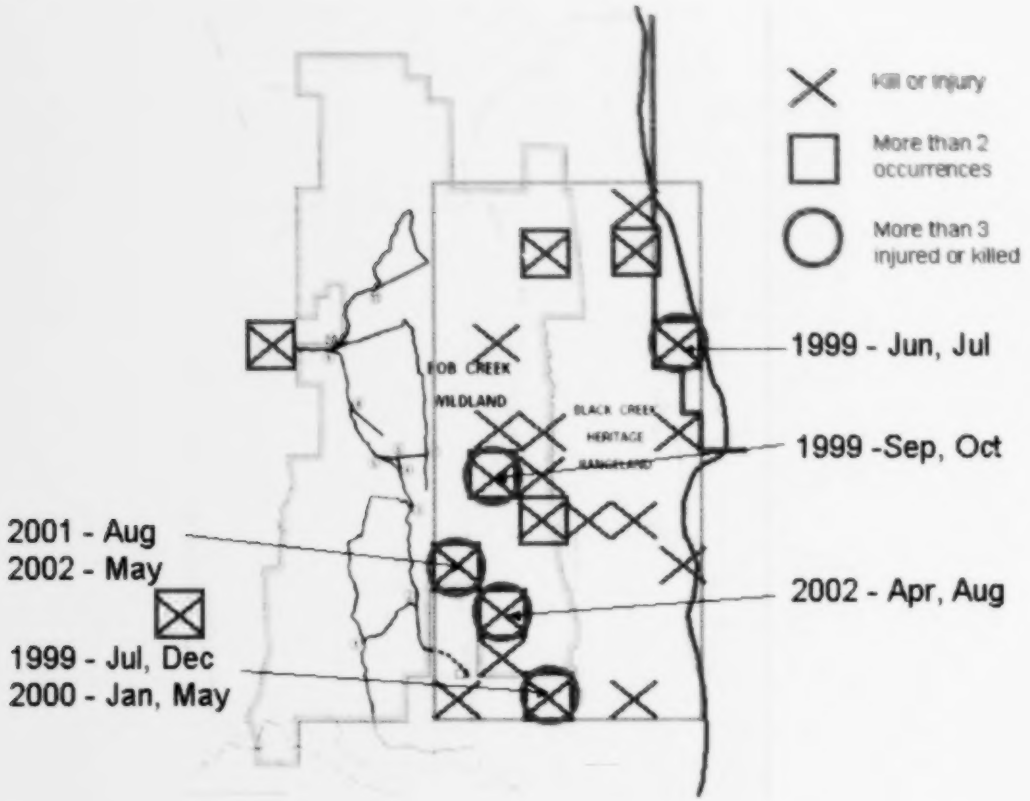


Figure 5. Spatial arrangement of wolf depredation activity, by township, north of Highway 3, 1999-2002 (WMU's 304-306, 308). Areas outside of map, but with in these WMU boundaries did not experience any confirmed wolf conflicts (C. Bergman, 7 Nov 2002).

Livestock producer impact of wolf-cattle conflicts

It is important to consider conflict frequency from the perspective of the individual producer (defined as an individual owning cattle; grazing co-ops may have multiple producers). Twenty-six livestock producers owned cattle killed or injured by wolves in the area north of Highway 3, from 1999-2002. Three of these producers lost/had injured more than five cattle: the producer suffering the greatest confirmed losses had 16 cattle confirmed killed by wolves, two cattle that were injured and destroyed, and five cattle injured and healed. A second producer lost five cattle to wolves, with an additional one that was injured and healed. A third lost three cattle and destroyed two more injured animals. Twenty-three of the total 26 affected producers suffered four or

fewer losses over four years: one producer reported 4 incidents of depredation, four producers had three depredation incidents, four producers had two incidents, and fourteen producers had one head of livestock killed or injured (Table 1). Likewise, it is important to consider depredation losses relative to the number of cattle at risk. These figures have not yet been produced.

Table 1. Summary of producer losses to wolf depredation activity in Pincher Creek Management Area, north of Highway 3 (WMU's 303-308, 400) from 1999-2002.

Producer	# Cattle killed by wolves	# Cattle injured by wolves and destroyed	# Cattle injured by wolves and recovered
1	16	2	5
2	5	0	1
3	3	2	0
4	1	2	1
5	3	0	0
6	3	0	0
7	2	0	1
8	1	1	1
9	2	0	0
10	1	0	1
11	2	0	0
12	0	1	1
13	1	0	0
14	1	0	0
15	1	0	0
16	1	0	0
17	1	0	0
18	1	0	0
19	1	0	0
20	1	0	0
21	1	0	0
22	1	0	0
23	0	1	0
24	0	1	0
25	0	1	0
26	0	0	1
4-YEAR TOTAL	49	11	12

Limitations of depredation data

Depredation summaries are based on ***confirmed*** reports of livestock losses or injuries reported to F&W staff by members of the ranching community. It should be noted that total numbers are an under representation of total losses, since not all losses are reported to F&W (CAG, rancher comments). Moreover, when considering the full impact of wolves on ranching operations, one must also consider the extra time and expense that ranchers invest to deal with depredation problems or wolf harassment (attending to investigations with officers, filing reports, fixing fences and sorting cattle when herds

mix due to wolf harassment, losses of irreplaceable breeding stock, lower rates of weight gain when harassment is consistent, uneven grazing patterns, mental stress, etc.). Research in the Yellowstone ecosystem has shown that actual losses from predators may be over 170% greater than confirmed losses. It should also be kept in mind that absolute numbers of losses should not be perceived in isolation, but rather in relation to the total number of cattle that are at risk of wolf depredation. There are calls for "full cost accounting" of depredation and grazing, from stakeholders representing the full suite of views.

III. Progress in management: June 2003 to August 2004

Need for a local management strategy

Following the publication of the provincial wolf management plan in 1991, it was recognized that a management strategy was required that was tailored to address local needs. A draft four-page strategy (Oldman Wolf Strategy; Quinlan 1998) was thus created. It emphasized six key components: a population goal (50 wolves); an inventory of population size and pack territories; regulatory changes to permit limitations on annual mortality; more effective, targeted and timely response to cattle depredations; implementation of a multi-stakeholder advisory group endorsed by the Minister to review wolf management in the area; and, an adequate budget to implement all components. Included in the budget would be one half-time position dedicated year-round to wolf management. This strategy was not officially endorsed or implemented, but remains a strong basis underlying current direction in wolf management in the Pincher Creek management area.

A review of direction for local wolf management

While in general agreement with the components of the original draft Oldman Basin Wolf Strategy, the current area biologist, Carita Bergman, believed that the first step forward in local wolf management would have to be the formation of a local stakeholder committee, which would conduct a full review and make recommendations for future actions. Other components of the old draft strategy involved furthering our knowledge of local wolf populations, and that would inevitably involve catching, radio collaring and releasing wolves in the area. The last attempt to conduct such work in the early 1990's raised public awareness of wolves in the area, and all collared individuals were killed. Very few wolves remained. Only with local support would it be possible to conduct collaring of wolves. On a positive note, public education efforts by SACC over the previous 3 years had helped to build landowner support for changes to wolf management. Still, the problem of budget remained, and no action was possible until 2003 when funds were available for the first time.

Formation of the Oldman Basin Carnivore Advisory Group

Following significant losses of cattle in the Bob Creek area from 1999-2002, it was expected that the problem would again be severe in 2003. Strychnine had been used for a brief period in the spring of 2002 with no success, and it was suggested by problem wildlife experts with F&W that similar control should be implemented in the Bob Creek

Wildland Park should the depredation continue. The urgency of the situation, unresolved issues surrounding the use of poisons such as strychnine, and a widespread desire amongst agency staff and stakeholders to avoid using poison for wolf control when possible, led to the formation of the Oldman Basin Carnivore Advisory Group (hereafter known as the "Advisory Group") in the summer of 2003 (for Terms of Reference and Membership, see Appendix 2). General roles of the Advisory Group include:

- Promoting cooperation in large carnivore management and conservation
- Providing a means for effective local representation and participation
- Identifying potential carnivore management principles, goals and actions
- Developing and managing a model work plan for the achievement of carnivore management goals (including budgeting and funding support development)
- Reporting to and providing recommendations to F&W, towards creating a local carnivore management framework

The Advisory Group has met nine times over the course of the last year (Table 2), providing input and suggestions for consideration by wildlife management and problem wildlife staff.

Table 2. Oldman Basin Carnivore Advisory Group meeting summary, June 2003 – August 2004.

Date	Meeting Place	# attending
26 June 2003	Chain Lakes	8
31 July 2003	Chain Lakes	11
2 October 2003	Chain Lakes	11
12 November 2003	Claresholm	9
15 January 2004	Claresholm	11
15 February 2004	Chain Lakes	10
18 March 2004	Chain Lakes	10
22 April 2004	Teleconference	9
22 July 2004	Chain Lakes	10

Initial focus of Advisory Group meetings

A desire to rapidly incorporate stakeholder input into management response to wolf depredation issues focussed initial discussion of the Advisory Group on current local wolf knowledge and depredation issues in the area, followed by ongoing discussion of issues and possible solutions (Appendix 3). All stakeholders at the table recognized that effective management of cattle depredation needed to be a focal component of wolf management in southwest Alberta, and indeed this policy was key to achieving support from the ranching community for wolf conservation.

At the outset, one of the greatest problems identified with current management decisions was the lack of biological information regarding the SW Alberta wolf population, including pack locations, sizes and movements, as well as knowledge that allowed various depredation events to be linked to specific wolves or packs of wolves. The Advisory Group recognized that control efforts, when necessary, should target only

wolves that were specifically involved in cattle conflicts. However, it was difficult to identify those wolves, or to define an acceptable method of control that would allow only these individuals to be targeted.

By August 2003, it had become apparent that there were few conflicts in the Bob Creek area, and in addition very little wolf sign. This was likely due to the relatively large number of wolves removed from the area through legal hunting (two by ranchers, four by hunters) and trapping (six), in the winter of 2001-2002. In contrast, wolf-livestock conflicts in the Willow Creek area were accelerating. The Advisory Group agreed that trapping efforts should begin to allow wolves to be radio collared and tracked. This action would then allow firm determination of the wolves involved in specific conflicts. The Advisory Group also recommended that if the depredations continued after wolves were collared, and if collared wolves were linked to depredation, that F&W should respond through incremental targeted removal of individuals from the depredatory pack (Appendix 4), continuing until the problem of depredations was reduced to a tolerable level.

Through the course of many discussions, the Advisory Group reviewed the original elements of the draft Oldman Basin Wolf Strategy (Quinlan1998): a population goal (50 wolves); an inventory of population size and pack territories; regulatory changes to permit limit to annual mortality; more effective, targeted and timely response to cattle depredations; implementation of a multi-stakeholder advisory committee endorsed by the Minister to review wolf management in the area; dedicated staff; and, sufficient budgetary allowance to accomplish needed work. Discussion and F&W perspective is given below:

Element 1: Population goal

Discussion of Advisory Group

The idea of a fixed wolf population goal remains a controversial issue. From a conservation perspective, the goal should be sufficiently high to maintain a viable population, yet the scale of viability needs also to be sufficiently defined, and a number alone is not of much use. From a ranching perspective, a population goal may be undesirable if it prevents effective response to cattle depredation issues. No consensus was reached as to an appropriate goal. In contrast, it was agreed that without sufficient biological knowledge of the population (currently lacking), setting a goal will be difficult, at best. Further, it was suggested we consider an ecological, rather numeric goal, though this was not elaborated.

Fish and Wildlife Perspective

Data from other jurisdictions where wolf populations are increasing and livestock are plentiful have shown that not all wolf packs prey on livestock (Poland – Jedrzejewski et al. 2003; USA – Treves et al. 2003). Even north of the study area, data indicate that non-depredating packs in the Highwood and Sheep River drainages exist (C. Mamo, personal communication). Therefore, in the study area it is also likely the case that both wolf packs that depredate cattle and those that do not, exist. This is supported by local rancher (Anonymous 2004) belief that there are both "good" wolves and "bad" wolves

that inhabit the area. Whether this is a static situation (the same packs always kill/do not kill livestock) or a dynamic one (at one point in time, some packs kill/do not kill livestock) is unknown.

In the short term, then, we believe that the focus of local wolf management should be limiting mortality in wolf packs that are not involved in cattle depredation, while continuing to implement control measures directed towards wolf packs or individuals that prey on livestock. By doing so, it may be possible to obtain a measure of stability amongst the non-depredating wolf packs, and thus increase the connectivity between wolf populations to the south (USA) and to the north (Kananaskis Country, Banff, etc.), through increased dispersal, as is desirable according to the provincial management plan. Ranchers, in cooperation with conservation organizations and provincial agents, are encouraged to continue to experiment with non-lethal stewardship and other methods to reduce the likelihood of depredation by wolves. Furthermore, managing for a numeric population goal should be postponed until 1) better local biological data have been collected, and 2) effective response to cattle depredation has been achieved.

Element 2: Inventory of pack sizes, territories and demography

Discussion of Advisory Group

It was unanimously agreed that biological information crucial to decision-making was almost completely lacking, and that immediate effort should be applied to identifying local wolf pack locations, movements, sizes, and reproductive and survival information. It was also agreed that collaring and tracking of wolves was the most efficient method of gathering this information. Satellite collars, although prone to higher failure rates, were preferred since data could be obtained remotely, accurately and more frequently, compared with that obtained with VHF collars.

Fish and Wildlife Perspective

In agreement with discussion of Advisory Group. To obtain the best information with inconsistent field staff, one Argos satellite collar (transmitting daily locations via satellite) shall be deployed in a single pack, with 2-4 VHF collars (transmitting a radio signal detectable on the ground) deployed on additional pack members to allow the pack to be located in the event that the satellite collar dies, or multiple members of the pack are killed.

Element 3: Regulatory changes to permit management of annual wolf mortality rates

Discussion of Advisory Group

The Advisory Group recognized that regulatory changes were a necessary component of improved wolf management in the area. Potentially, certain regulation changes may assist in better collection of biological data, and in implementing management goals. The Advisory Group voted to put forth the following recommendations for consideration as possible regulation changes in 2004:

1- requirement for a hunting licence for hunters wishing to harvest wolves (allow easier monitoring of wolf registrations and success rate of hunters)
2- changing compensation for depredation to reflect a pre-BSE fall market price, rather than actual market price at time of depredation (to more closely reflect the true costs incurred by ranchers in dealing with losses to wolf depredation)
3- hunters to provide tissue samples (and skulls for aging)to F&W to allow genetic work (to allow better knowledge on the impacts of hunting on individual packs through genetic analysis of tissue)

The first recommendation was not supported at F&W Management headquarters level, as it is believed that the hunter success is already very low, and that the requirement for a licence may further decrease the number of wolves harvested by hunters; hunting is supported as one effective way of reducing wolf numbers in problem areas.

The second recommendation was supported at headquarters level of the Wildlife Management Branch; this is being pursued through though the Division's legislative amendment process.

The third recommendation was supported at headquarters level, but was not implemented because of perceived staff shortages to collect and process required samples.

Fish and Wildlife Perspective

The above regulatory changes are supported at the local level. For the future, if we are to achieve more stability in wolf packs not involved in cattle depredation, and manage these packs with similar considerations afforded other ungulate and carnivore wildlife species, regulatory mechanisms must exist that allow limitations to be placed on annual mortality. One solution would be to define wolf management areas (as we have bear and cougar management areas), and set targets for annual mortality. These targets could be liberal for areas where depredation is chronic, but more restrictive in areas where conflicts are not an issue. Regulations require further and continual review based on improvements in local biological knowledge, and our improved effectiveness in managing conflict situations.

Element 4: More effective, targeted and timely management response to cattle depredations

Discussion of Advisory Group

Discussions of the Advisory Group often focussed on this issue. From a conservation perspective, it is desirable to continue research into effective non-lethal methods that may help in preventing or reducing cattle depredation, while minimizing the need to cyclically reduce wolf numbers (Appendix 5).

From a ranching perspective, participation in research is difficult due to the costs involved in additional labour, costs incurred when non-lethal methods fail, and the social difficulty of "moving the problem to the neighbour's," that may occur when wolves are deterred from depredation in small, localized areas (Musiani et al. 2003). Ultimately,

many ranchers would like to have non-lethal deterrents available, but at this time are not convinced that effective, long-term methods exist. On the other hand, there are some who recognize that although there may be a cost to investigating new techniques and changing management practices, this cost may balance out with current costs of operation that result from wolf depredation. The current economic crises caused by outbreak of bovine spongiform encephalitis (BSE) has not improved the situation. On a brighter note, many local ranchers continue to take proactive measures to minimize their risk of wolf predation, indicating some confidence in these measures (Section IV). In addition, Defenders of Wildlife Canada, pending available funding, is willing to underwrite the costs of implementing and testing non-lethal methods. There is a need to investigate such methods systematically and report results to interested parties.

There was general unanimous agreement, that at least in the short term, there was a need for lethal control in some chronic cases of livestock depredation, and that this control should be targeted as specifically as possible to those wolves involved in the depredation events. The Advisory Group was split evenly on whether lethal control should continue in the long-term, and what suite of methods were acceptable. In the immediate instance where lethal control was agreed upon by all sides (Willow Creek pack), support was unanimous for helicopter capture and euthanization, due to its specificity of action. There was some concern expressed that lethal removal of wolves by government may reduce opportunity for hunting and trapping. Toxicants were rated as the least desirable control option by some committee members, and unacceptable under any circumstances by other members (conservation interests, and Community Development within Protected Areas).

Fish and Wildlife Perspective

This element is crucial to improving wolf management and maintaining viable wolf populations in southwest Alberta. Most wolf mortality is related ultimately to livestock-wolf conflicts. Hunting and trapping pressure is increased in areas receiving chronic depredations, and large reductions in wolf numbers are often the result. Current research being conducted in both the United States and Canada has shown that many non-lethal techniques are either effective only on a small spatial scale (Asher et al. 2003; Musiani et al. 2003), or effective only for short periods (Asher et al. 2003; Shivik et al. 2003) (see summary of non-lethal techniques in Appendix 5). While it is desirable to explore and implement effective techniques, current budgets permit minimal, if any, true experimental work on non-lethal control, and research conducted elsewhere does not show that non-lethal methods alone are sufficient at the scale of the population in reducing depredation to a "tolerable level." Opportunities to implement non-lethal control will be examined on a case-by-case basis, and explored when possible resources exist. There is some potential here for collaborative efforts with non-governmental organizations.

Given the novelty of collared wolves in depredating packs during this report year, several methods of targeted lethal control were attempted in the following order: ground based shooting of known depredating wolves by agency staff, ground based shooting of known depredating wolves by contract staff, reliance on hunting to reduce wolf numbers, working with local trappers to live snare wolves that could then be euthanized or released, with an attempt made to maintain collared individuals in the remaining pack;

helicopter net capture and euthanization. The latter method was proven to be the most efficient, timely and cost effective method of targeting specific depredating wolves, when collared individuals exist. A potentially more effective and humane method may be to shoot targeted individual wolves directly from the helicopter, as is done in the southern United States (where wolf populations continue to increase), although this method is currently not employed in Alberta. One problem with implementing such a method is negative public reaction, which may be based on non-selective shooting of wolves from helicopters that has been conducted in BC, Yukon, and Alaska for general population reduction reasons. With sufficient education that non-selective control is not desirable or acceptable in SW Alberta, such negative reaction may be avoidable.

Element 5: Dedicated wolf management staff

Discussion of Advisory Group

The Advisory Group recognizes that there are no staff solely dedicated to wolf management in the Pincher Creek area, and that both biological and enforcement staff struggle to allocate sufficient time and resources to implement desired wolf management actions. The Advisory Group strongly recommends that more staff and money be made available to insure results and maintain the credibility of the Group. Staffing may be borne, in part, by non-government organizations or individuals in coordination with F&W. For example, a contract to the Alberta Beef Producers and Defenders of Wildlife Canada provided assistance in monitoring of collared wolves, communicating with landowners, and assisting ranchers in observing and moving cattle during the summer and fall of 2003. Local trappers have also provided key assistance under contract to capture and to assist in collaring wolves.

Fish and Wildlife Perspective

In agreement with the original draft of the Oldman Basin Wolf Strategy, it is suggested that at least one half-time position (possible using existing staff) be dedicated to local wolf management needs, including collection of biological data, landowner education, data summary analysis, and research into non-lethal techniques. Coordinated contributions from non-governmental organizations and others should be considered.

Element 6: Budget

Discussion of Advisory Group

The Advisory Group recognizes that a sufficient budget for wolf management needs to be allocated to cover the desired management activities, that the allocation in 2003-2004 was the first ever allocation of such funds (Appendix 6), and that although much was accomplished with the allocation in 2003-2004, the need is ongoing. Opportunities exist for in-kind and other contributions. For example, the Alberta Beef Producers, in cooperation with Defenders of Wildlife Canada, provided funds to cover some efforts supported by the Advisory Group in 2003-2004. In addition, the Province provided lodging and the use of vehicles and other equipment. University researchers are

potential contributors. There was general agreement that the reduction in funds for the second year of work may have negative impacts on future success.

Fish and Wildlife Perspective

A dedicated and consistent budget is crucial to accomplishing management plans. Collaboration with outside agencies will be key to accomplishing goals if sufficient funding is to be secured. Limitations of staff restrict ability to solicit outside funds.

IV. Prevention of depredation

The goals of the 1991 management plan, the 1998 Oldman Basin Wolf Strategy, and the Advisory Group will be met only with a broad and adaptive suite of effective tactics aimed at preventing depredation, assisting and compensating ranchers, eliminating habitual depredators, managing and conserving wolves, retaining communication and coordination among stakeholders and educating target audiences. Measures to prevent of depredation can play a crucial role in progress toward the goals of these plans and efforts.

Anecdotal information leads us to believe that once a wolf pack begins to prey on livestock, the pattern becomes established quickly, and it may be extremely difficult to reverse the behaviour. To their credit, this is recognized by many ranchers, with the result that prevention of wolf depredation is often characteristic of their management practices. Local examples of prevention include rapid removal of livestock carcasses, either to a rendering plant, or to areas outside of wolf range. The use of calving sheds and areas close to occupied buildings is another example. On open range, some ranchers place more vulnerable livestock in areas less prone to wolf depredation. Others ride their herds frequently, and by stopping wolves in the act of harassment, or simply by increased human presence, may prevent problems from establishing. One creative solution to bearing the financial loss of wolf depredation is implemented through a local grazing cooperative in which each producer pays a small premium as insurance against predator losses, and are then compensated individually for any losses that occur.

These methods are not one-size-fits-all propositions, but must be considered and tailored to individual circumstances. For the most part, these are relatively isolated examples, and are not widely practiced across the region. Opportunities exist to test these methods in additional locations, and to support ranchers willing to experiment with non-lethal methods.

As resource extraction and recreation pressure on public lands continues to increase, the importance of private lands in ecosystem function and conservation of natural resources cannot be understated. Rancher stewardship practices thus have potential to benefit wider society, yet this is rarely recognized by the urban sector. Employing non-lethal methods could help garner increased public support for Alberta ranchers.

Value of a presence in the field

On behalf of the Southern Alberta Conservation Cooperative, Charles Mamo had been a seasonal presence in SW Alberta between 1999 and 2002, meeting regularly with and assisting ranchers, observing the behaviour of wolves, and conducting experiments in

non-lethal methods to reduce depredations. Mamo was hired in September 2003 under contract to the Alberta Beef Producers with funding provided by Defenders of Wildlife Canada. His responsibilities included riding cattle ranges in the Willow Creek area, tracking wolves, observing wolves and cattle, using non-lethal means to stop depredations, and assisting ranchers as possible, Sponsors intended that he would coordinate efforts closely with the Advisory Group and help complement efforts of the under-resourced provincial F&W staff.

As an almost daily presence on foot and horseback, Mamo was able to track and observe the Willow Creek wolf pack (including their splitting to two groups which foraged in different areas), count the numbers of adults and pups, identify their den and rendezvous sites, and identify depredations that otherwise might have gone undetected by operators (resulting in additional compensation paid). He confirmed the role of Willow Creek wolves in depredation events, observed the role of grizzlies in driving wolves from their kills (likely necessitating additional kills by the pack). He reported wolf movements to ranchers so they could adjust their management accordingly and frequently assisted operators in moving or otherwise managing cattle. On one occasion, he intercepted wolves pursuing cattle and drove them off. The Willow Creek pack did not return to those heifers for three weeks.

In addition, Charles met regularly with ranchers and operators to understand their concerns regarding wolves, discuss the effectiveness of measures to discourage depredation, and explain what he and the Advisory Group were up to. This critical communication role helped reassure ranchers that efforts were being made to reduce depredation by wolves and tapped critical rancher knowledge.

Four years of effort has demonstrated that a personal field presence provides a necessary complement to telemetry technology and to short-handed government agencies and ranchers. Additional field staff can observe actual wolf numbers and behaviour, identify kills (natural game and livestock), and note other contributing factors. They provide timely and pertinent information to livestock operators. When appropriate, they can assist ranchers in managing cattle and in directly preventing depredations. This role offers the ENGO community an important opportunity to contribute to the efforts of provincial departments and rancher/operators.

V. Population update

The following data and discussion are based on individual wolf packs, defined as a breeding pair and offspring from several years (but see Meier et al. 1995) living in close association and sharing a defended home territory.

A. Willow Creek Pack

Biological information

In 2003, the capture of five wolves (collaring of four, as one was deemed too young) in this pack by contract biologist Charles Mamo allowed determination of several biological parameters. In August 2003, with four wolves trapped and collared (three pups and one subordinate adult) and a contract biologist working on the ground to track these

wolves, it was determined that the pack was composed of eight pups, and six adults, all gray in colour. By mid-January, this pack had been reduced to two pups and four adults, with the alpha female being removed in the process. A detailed list of management actions affecting this pack is presented in Table 3.

Table 3. Management actions affecting the Willow Creek wolf pack, implemented by F&W with multi-stakeholder support.

Date	**Management Action**
June 2003	Establishment of local stakeholder advisory group
August 1 – September 24, 2003	Contract biologist Charles Mamo working jointly through F&W and Defenders of Wildlife Canada funding to provide extra riding in areas of wolf depredation, and to capture/collar wolves in Willow Creek area
August 1-19, 2003	Live trapping conducted in Willow Creek (C. Mamo)
August 13, 15, 18, 19, 2003	Five wolves trapped and released, four wearing VHF radio collars (C. Mamo)
August 19-September 24, 2003	Collared wolves tracked daily/weekly on ground (C. Mamo – see Appendix 7.); 14 wolves (including 8 pups) determined to comprise Willow Creek pack
September 15 – September 23, 2003	Following continued depredation (see Table 4), attempt to reduce pack of 14 by 6 wolves, targeting breeding pair; no wolves removed.
Late Sept - October 2003	Efforts by F&W staff to reduce pack through ground-based hunting.
September 29, 2003	Male wolf (pup) shot on ground by F&W contract staff
September 30, 2003	Male wolf (pup) shot on ground by rancher (collared; #80)
October 9, 2003	Female wolf (pup) shot on ground by F&W contract staff
November 25, 2003	Wolf shot on ground by hunter (collared #77)
November 15 – December, 2003	Work with local trapper to live catch wolves in Willow Creek territory; lack of snow hinders success
January 8, 2004	1 wolf captured by helicopter and released with Argos satellite collar; pack territory boundaries subsequently defined with data obtained, and links to depredation possible
January 8, 2004	4 wolves captured by helicopter and euthanized by F&W (alpha female, subordinate adult male, and 2 pups)
March 18, 2004	2 wolves captured by helicopter and euthanized by F&W (alpha male and new alpha female)
May 7, 2004	Male yearling wolf (#78) begins dispersal to Montana; tracked by satellite
August 9, 2004	C. Mamo hired by Defenders of Wildlife Canada, with support from F&W to look for sign in Willow Creek (2 days)
August 13, 2004	Tracks of two adult wolves observed at old rendezvous site

In January, one of the previously collared pups (#78) was fitted with an Argos satellite collar and released, subsequently producing daily locations, and assisting in better defining the territory boundaries and pack movements (with the assumption that this individual's data represented roughly the pack behaviour). The deployment of this satellite collar was a first in SW Alberta, and resulted in the collection of a large amount of locational data (Figure 6). In general, the pack territory (based largely on movements of #78) appeared to encompass the area between Highway 532 (with some excursions just south of the road) and Eden Valley Reserve to the north. No overlap was observed with the Bob Creek pack territory to the south.

Satellite data revealed that the winter territory was a relatively small one (420 km^2; 100% MCP); this is not unexpected, since ungulate prey density is very high, pack size is small, and there is an established relationship between size of an animal's territory or home range, and the food density within that range (Pedersen 2003). In comparison, wolf territories in Algonquin Park, Ontario average 2800 km^2 (Forbes and Theberge 1995), 3000 km^2 in Quebec (La Verendrye, Messier 1985), and 1259 km^2 in Scandinavia (Pedersen 2003). In Poland, where wolf prey is primarily red deer (elk), wolf territories were similar in size to SW Alberta, averaging 520 km^2 (Jedrzejewska et al. 2000). On Isle Royale where wolves coexist with high densities of moose, wolf territories average 544 km^2 (Peterson and Page 1988). It is possible that continued monitoring over time will show increased home range size of wolf packs in SW Alberta, as summer movements are accounted for, though this has not been the case so far (see other pack information). It is unclear to what extent the social disruption of wolf removal may have had on movements of surviving individuals.

Figure 6. Movements of male pup (born in Spring 2003; #78), from January 2004 until his dispersal south in May. Data are colour coded by month.

As livestock conflicts in the Willow Creek pack territory continued through March 2004, the Willow Creek pack was incrementally reduced to four wolves: a male pup #78 from the previous year, a VHF collared subordinate female adult, and two others (one subordinate adult and one pup from previous year). Insufficient resources did not permit consistent tracking of the VHF collared adult, but satellite data indicated that the male pup #78 dispersed to Montana, beginning his movement in early May (the most common dispersal month for wolves). By June, this wolf had travelled into Montana and settled just northwest of Helena, Montana. According to federal wolf managers there, he had taken up residence in the Halfway Pack territory, and was observed with a collared 2-3 year-old female (the only wolf left in this pack after it was also reduced due to depredation events). This pair was later joined by a third wolf, also a male. Since that time, satellite data indicate that #78 continues to occupy the Halfway Pack territory.

Ground survey of the Willow Creek territory by a contract biologist in August 2004 showed very little sign of wolf activity. There was no sign of denning or pups, but visual observations and tracks of three adult wolves (including the collared female) were located near last year's rendezvous site. It appears that the remaining wolves continue to occupy the previously identified territory. Approximately ¾ of wolf pack territories in which a pack has dissolved or been destroyed are reoccupied by wolves within a short time (Brainerd et al. 2003).

Depredation information

Twenty eight cattle were reported killed or injured by wolves in the Willow Creek territory in the past year (Table 4). A survey of the eight livestock producers owning land within the Willow Creek wolf pack territory concluded that about 2220 cattle were present during the winter of 2003-2004 (within the home range of the Willow Creek pack). Depredations escalated in late June 2003, and continued through the summer and fall months. In an effort to minimize depredation and employ non-lethal prevention, the Alberta Beef Producers, using funds from Defenders of Wildlife Canada, hired a range rider to provide extra human presence in the area of wolf activity, as well as to provide some monitoring of collared wolves. This individual worked with local ranchers to communicate knowledge gained from collared wolves and his daily ground tracking. A radio receiver was also provided to one of the ranch managers for use in monitoring wolf presence, under the agreement that wolves would not be shot unless in the act of harassing cattle.

Providing receivers to cooperating ranchers is also a technique employed by US Fish and Wildlife Service (Joe Fontaine, personal communication). A draft protocol has been developed to facilitate this management technique (Appendix 8). As a result of continued depredations, actions were taken to reduce the Willow Creek pack incrementally, as long as significant depredation was occurring. We adopted this approach based on management response in the US that suggests depredation may be discouraged by removal of individual members from depredating packs (E. Bradley, personal communication). Following the removal of four wolves through the fall by hunters, ranchers (one shot while harassing cattle when ranch manager alerted to nearby wolf activity by range rider), and F&W, depredation continued, and four more wolves were removed from the pack in January. Because the territory was small, the pack could

rapidly travel throughout the entire territory within 24-48 hours. With a 24 hour delay in receiving data, it was therefore difficult to warn ranchers that wolves were in their area. As depredations continued after the removal of 10 wolves, two more wolves were removed in March 2004, leaving two wolves on the territory. At this point, movements decreased, and was confined primarily to two small areas of the former territory.

Table 4. Summary of depredations in the Willow Creek area, June 2003 – August 2004. "Retro=Y" refers to the retroactive determination that the Willow Creek pack was responsible for the depredation, once the territory and movement patterns had been identified.

Date	# livestock killed by wolves	# livestock injured by wolves and put down	# livestock injured by wolves, and recovered	Producer receiving losses	Willow Creek wolf pack linked with telemetry data to kills
June 29, 2003	1 yearling			1	No(retro=Y)
July 7, 2003	3 yearlings			1	No(retro=Y)
July 10, 2003	3 yearlings			1	No(retro=Y)
July 12, 2003	1 yearling			6	No(retro=Y)
July 13, 2003	1 yearling			1	No(retro=Y)
July 21, 2003		1 cow		7	No(retro=Y)
August 12, 2003	1 calf			7	No(retro=Y)
August 16, 2003		1 yearling		8	No(retro=Y)
August 28, 2003	1 yearling			6	No(retro=Y)
September 3, 2003	1 yearling			6	Yes-aerial telemetry locates wolves nearby
September 19, 2003	2 calves			1	No(retro=Y)
September 29, 2003	1 cow			9	No(retro=Y)
October 2, 2003	1 cow			2	No(retro=Y)
October 8, 2003	1 cow			3	No(retro=Y)
October 13, 2003	1 cow			3	No(retro=Y)
October 14, 2003	1 cow			4	No(retro=Y)
October 22, 2003	1 cow			5	No(retro=Y)
November 4, 2003	1 yearling			10	No(retro=Y)
December 10, 2003		1 cow		11	No(retro=Y)
March 11, 2004		1 yearling		1	Yes-satellite location/ ground telemetry
March 13, 2004	1 yearling			12	Yes-satellite location
March 14, 2004	1 yearling			12	Yes-satellite location
March 15, 2004			1 yearling	12	Yes-satellite location

B. Bob Creek Pack

Biological information

Collaring of four wolves in this pack allowed determination of several biological parameters. Key to this collaring effort was work with a local trapper who had intimate

knowledge of the wolf territory as it encompassed his registered trapline. Using stoppered neck snares, a single wolf (female pup) was collared and released in February with an Argos satellite collar. This allowed the pack to be easily located, and another two VHF collars and one Argos collar were deployed in late February and March as backups (two adult females, and one adult male – including what is believed to be the breeding pair). It was determined that the pack was composed of at least six wolves, (one or two are black in colour, others are gray or gray-brown). A detailed list of management actions affecting this pack is presented in Table 5.

Table 5. Management actions affecting the Bob Creek wolf pack, implemented by F&W with multi-stakeholder support.

Date	**Management Action**
June 2003	Establishment of local stakeholder advisory group
January - February, 2004	Live snaring conducted in Bob Creek
February 5, 2004	One female juvenile wolf snared and released wearing Argos satellite collar
February 23, 2004	Two female wolves caught with helicopter net capture and released with VHF collars.
March 20, 2004	One male wolf caught with helicopter net capture and released with VHF collar.
March, 2004	Ranch manager monitors wolf presence and proactively shoots in air to scare off wolves when present
April 19, 2004	Alpha male wolf removed from pack, aerial capture and euthanization; 6 wolves observed before removal of male.
April 22, 2004	Ranchers agree to try nightrider experiment (Appendix 9); not conducted, as depredation had ceased
April-July 2004	Continued monitoring through satellite locations
July 2004	Nursery/denning area determined through satellite data and ground observation; one pup observed
August 14, 2004	Two pups observed with adults.
August, 2004	Male wolf (black, 114 lbs) shot in Porcupine Hills (Bob Creek pack territory)

Argos satellite data assisted in defining territory boundaries and movements of this pack (with the assumption that this individual's data represented roughly the pack behaviour) (Figure 7). In general, the pack territory appeared to encompass the area south of Chain Lakes (with some excursions up the west side of the Lakes) to the Oldman River in the south. No movements into the Willow Creek territory were recorded, even after wolves were removed from that pack. No movements west of the Livingstone Range, or south of the Oldman River were recorded. On limited occasions, this pack did travel east of Highway 22 into the Porcupine Hills on both private and Forest Reserve land. Satellite data revealed that, compared to Willow Creek, the territory was a even smaller at 370 km^2, even though this included movements into the summer months.

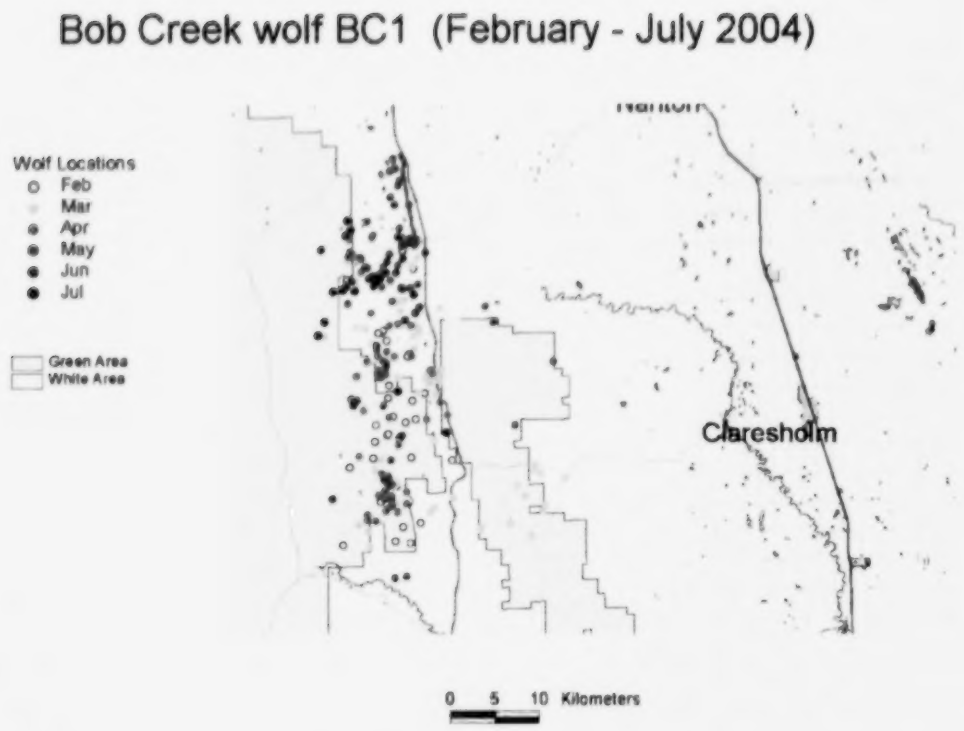


Figure 7. Movements of female adult in Bob Creek wolf pack, from February to July 2004. Data are colour coded by month.

Depredation information

Fifteen cattle were reported killed or injured by wolves in the Bob Creek territory in the past year (Table 6). Cattle depredations began in February in the eastern part of the Bob Creek territory (Porcupine Hills), and accelerated through March and April when cattle were moved into grazing allotments further west. The manager of the cattle in this allotment was provided with a radio receiver so that he could monitor wolf presence in the vicinity of the cattle. On several occasions he shot in the air when he detected the wolves, and believed that this resulted in the wolves temporarily leaving the area. Satellite data showed that the pack spent one to three days in the area of the cattle, then left for more northerly parts of their territory for a similar time before returning to the grazing allotment. This cycle was repeated for the duration of spring grazing in the allotment, and depredations were consistent. As a result of continued depredations, an incremental reduction plan for the wolf pack was implemented, and the alpha male wolf removed from the pack using aerial net capture and euthanization. US researchers have examined the likelihood of continued depredation after dominant or non-dominants are removed from packs; no trend is apparent (E. Bradley, personal communication), but the data are scant, and the question is worthy of further study. Therefore, the decision was made to first remove the alpha male from the Bob Creek pack, in contrast to the dominant male being one of the last wolves removed from the Willow Creek pack, as a test of this

idea. Following the removal of this wolf, depredation largely ceased (one incident of harassment on a grazing lease in mid-summer 2004).

Table 6. Summary of depredations in the Bob Creek area, June 2003 – August 2004.

Date	# livestock killed by wolves	# livestock injured by wolves and put down	# livestock injured by wolves, and recovered	Producer receiving losses	Occurrence number
July 24, 2003	1 steer			1	15420
August 8, 2003	1 steer	1 steer		1	18023
February 25, 2004	1 cow			2	32269
March 19, 2004	1 heifer			3	33047
March 22, 2004	1 pregnant cow			4	33235
April 2, 2004	1 yearling			1	678
April 3, 2004	1 yearling			5	531
April 5, 2004	1 yearling			1	707
April 5, 2004	1 yearling			5	1891
April 11, 2004	1 yearling			5	1895
April 14, 2004	1 heifer			6	1590
April 14, 2004	1 yearling			1	1844
April 19, 2004	1 yearling			1	4976
July 28, 2004			1 yearling	7	11018
July 30, 2004			1 yearling	1	11284

C. Castle-Carbondale Pack

Biological information

Collaring of two wolves in this pack allowed determination of several biological parameters. Key to this collaring effort was work with a local trapper whose intimate knowledge of the wolf territory led to success in the difficult initial capture and collaring. Using a bait site and padded foothold traps, two wolves (female pups) were collared and released in March, one with an Argos satellite collar. Although these individuals were easily located following capture, they did not appear with other pack members, and may have shown reduced movements as paws were recovering from normal trap trauma. One month after capture, these wolves increased their movements, and were observed later in the summer with other pack members. The trapper estimated that the winter pack size was at least six wolves, (all gray or gray-brown). In July 2004, a third wolf was captured and fitted with a satellite collar when the first collar had ceased to work. At this time, nine wolves were observed by the helicopter capture team, and a denning/nursery area also identified. A detailed list of management actions is presented in Table 7. Satellite data revealed that the territory was 460 km^2.

Table 7. Management actions affecting the Castle-Carbondale wolf pack.

Date	Management Action
June 2003	Establishment of local stakeholder advisory group
October 27, 2003	Male wolf shot by hunter
November 20, 2003	Male wolf shot by hunter
March 10, 2004	Two female pups caught with assistance of local trapper; fitted with one satellite, one VHF collar
July 4, 2004	First satellite collar fails to transmit, still functions as VHF
July 28, 2004	Subordinate female adult caught with helicopter capture, and Argos collar deployed; possible denning area located

Movements of the Castle-Carbondale pack were bounded by Highway 3 to the north, Highway 507 to the east, the Continental Divide to the west (with possible occasional short excursions into BC), and Highway 774 (road to Castle ski hill) to the south, with occasional activity in the Beaver Mines Lake and Gladstone Valley areas (Figure 8).

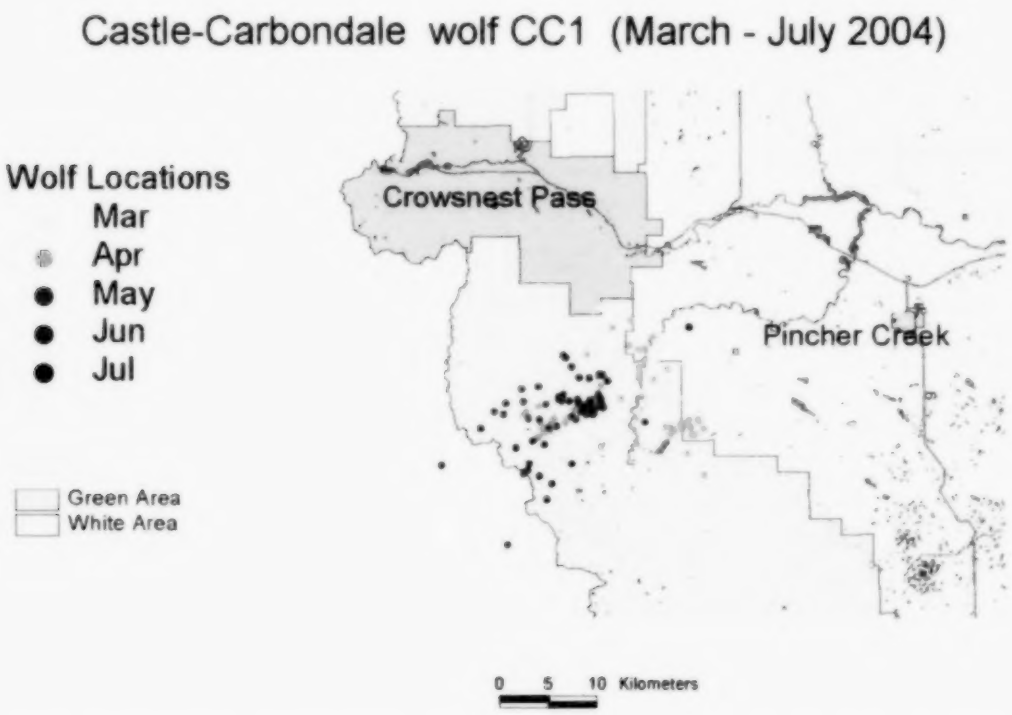


Figure 8. Movements of female pup, from March to July 2004. Data are colour coded by month.

Depredation information

No confirmed (or suspected) depredations have been recorded in this pack territory over the course of monitoring (or in the past several years). These results may change as the territory becomes better defined with data that encompass all seasons. Interestingly, there are no cattle resident in the winter range of this pack; Highway 507 from Beaver Mines to Lee Lake roughly demarcates the boundary of the pack territory, and of winter cattle distribution in the local area. We have not documented methods local operators may use to discourage depredation.

D. Other wolf sightings outside of defined/known territories

Aside from the three packs in which collars were deployed for the first time this past year, sightings of wolf pack activity outside of territory boundaries were recorded in several locations. These are listed below:

Waterton area: 8-17 wolves observed on various occasions through the winter and spring by local ranchers, landowners, park staff; one wolf shot from pack while feeding on cattle that died from other causes; no known depredation activity. A decayed carcass of an adult male wolf collared in Montana as an adult was discovered east of Waterton Lakes National Park (WLNP) in late April. A second wolf carcass was discovered along highway in southern part of WLNP in May 2004.

South Livingstone: one wolf shot southeast of The Gap, and several sightings of 1-5 wolves in the Maycroft area and south in the summer of 2003. Depredations reported in the Gold Creek area, and cattle harassed SE of The Gap. A collar with a bullet hole through it, and cut webbing was found in the Crowsnest area in October 2003, from a 4-year-old female wolf. This wolf was collared as a two-year-old in Banff 1999, when she was a member of the Fairholme pack. She was last located in Banff in the spring of 2002, at which time it was assumed she had dispersed (Tom Davidson, personal communication).

North Livingstone/Beehive: one wolf shot by hunter in fall 2003, and pack of 14 observed; repeated depredation in the Hidden Creek area NW of the Gap.

E. Population estimation

Using knowledge from a variety of sources (observations of F&W staff, contract biologists, reputable landowners, registered trappers, and hunters who harvested wolves), a population estimate of wolves for southwest Alberta was derived (Table 8). A conservative maximum estimate of 61 wolves includes packs when they were at their largest (with pups of year), while the minimum represents the sum of packs at their smallest after known annual mortality was taken into account, or when no mortality had been reported, the minimum number observed in the area (and is likely therefore conservative).

This population estimate includes wolves of all ages, including pups of the year. It does not include the Tent Mountain pack, a trans-boundary pack with BC, believed to

spend a portion of its time in Alberta. Legal registrations show that five wolves were removed from the Tent Mountain area in the winter of 2002-2003. The current status of the pack inhabiting the area is unknown.

Table 8. Information used in estimating population size of wolves in southwest Alberta study area, 2003-2004.

Pack location	# wolves in pack (peak)	# wolves in pack (low)	Information source
Willow Creek	14	1*	Collaring/direct observation
Bob Creek	7	5	Observation of capture team/trapper
Castle-Carbondale	9	6	Observation of trapper/capture team
Waterton/Twin Butte	17	8	Observation of hunter/ park wardens
South Livingstone	14	5	Landowner/hunter observation
POPULATION RANGE 2003-2004	**61 (high)**	**25 (low)**	

* Observations in October 2004 suggest minimum pack size was actually three (after dispersal of #78).

F. Survival rate estimation

"Survival rate" is the proportion (between 0 and 1) of a population that survive a pre-defined time interval, be it a year, month or day. "Mortality rate" is the proportion that die (or disperse out of the population) in a time interval, and is calculated as "1 – survival rate." Using the methods of Trent and Rongstad (Krebs 1989, p. 434) that incorporate the number of radio tracking days (1772 radio-wolf-days to end of August 2004), and dates and numbers of known deaths or dispersal of marked animals (four), a **daily finite survival rate of 0.9977** was estimated for the SW Alberta wolf population. If adjusted to an annual survival rate, the survival rate estimated from collared wolves is 44%. Although we have chosen to include dispersal in the estimate of mortality, it is usually excluded from such analyses.

Research indicates that mortality rates greater than 30-40% of early winter population (not daily mortality, as calculated above) can lead to a declining population (Carbyn et al. 1995). Assuming that "early winter" is 1 November in the conversion of the SW Alberta daily survival rate to a survival rate between November and April (182 days), an estimate of 0.663 is produced, i.e. the proportion of wolves surviving from November to April is 66%. The mortality rate for the same period is thus 0.337 (34%).

These data suggest that wolf mortality in 2003-2004 may not cause a decline or increase in the population in the following year. Given that wolves appear to have re-occupied habitat in SW Alberta since the 1970's, current **average** annual mortality (still unknown) may be sustainable - it remains imperative that mortality rates continue to be investigated with the intent of understanding annual variation in survival and its impact on population sustainability; this will require maintaining as many collared individual

wolves as is feasible, for a number of subsequent years. It remains unclear what the role of immigration is in maintaining current population levels.

One assumption underlying the extrapolation required to reach the survival and mortality estimates using radio collar data is that mortality is relatively constant through the year; in some areas, mortality is relatively higher in winter than summer due to intensive trapping or winter control. However, examination of dates of mortality in SW Alberta (Table 9), does not indicate a large bias towards winter.

Also to be considered when evaluating conclusions from these data is that the confidence intervals on the survival estimate are wide (using a binomial approximation), and thus it is imperative that the survival estimate and conclusions drawn from it should be treated with caution. It is further assumed that the marked (collared) wolves are a random sample of the population, and experience equal mortality risk as individuals. In fact this may not be true, since control efforts may in some circumstances target non-collared wolves (as in the Willow Creek pack, in contrast to the targeting of a collared wolf for removal in the Bob Creek pack), thereby biasing the survival rate in a positive direction.

With the potential biases discussed above, it is reassuring to compare above estimates with an independent measure of mortality. Using the conservative maximum population estimate (61 wolves - Table 8), and the known deaths or dispersal (21 deaths, 1 dispersal - Table 9), an *annual* mortality rate of 36% is generated (64% annual survival). This second estimate does not account for unreported deaths or unknown dispersal, so the real annual rate is likely somewhat higher. Conversion to winter mortality indicates a mortality rate of 20% between November and April (80% survival); this second mortality estimate is thus comparable to that calculated from collared wolves over the shorter winter period (34%).

More research on the population dynamics of wolves and simulations of the local population using appropriate demographic measures are required for a better understanding of what level of mortality can be sustained in the local population. An understanding of annual variation in survival rates is also required. Once again, it is imperative that mortality rates continue to be investigated, and this will require maintaining as many collared individual wolves as is feasible.

Table 9. Known deaths of wolves in southwest Alberta, August 2003 – August 2004.

Wolf Pack	Total known deaths	Deaths – Nov-Apr	Deaths – May-Oct
Willow Creek	12	9	3
Bob Creek	2	1	1
Castle-Carbondale	2	1	1
Waterton/Twin Butte	3	2	1
Livingstone/Beehive	3	1	2

F. Reproduction

All three packs that have been tracked (Willow Creek, Bob Creek and Castle-Carbondale) were known to have reproduced successfully in the summer of 2003, with eight pups observed in the Willow Creek pack, and an undetermined number in the Bob

Creek and Castle-Carbondale packs. In summer 2004, both the Bob Creek and Castle-Carbondale packs were known to have reproduced successfully, with a minimum of two and three pups, respectively (these are minimums – the presence of more pups is likely). No pups were produced in 2004 in the Willow Creek territory.

VI. Conclusions/Considerations

The unique challenges of wolf management in SW Alberta create the need for management actions tailored to the specific area. Many of these actions may be different from those characterizing other areas of wolf range in the province. The following characteristics need to be considered and accounted for if successful management is occur in SW Alberta:

1) The population of wolves in SW Alberta is small and vulnerable to rapid decline
2) Sharp landscape interface between prairie and treed mountain habitat (no foothill buffer zone) intensifies overlap of montane wolf populations with core cattle range
3) A large overlap of winter ungulate range with private and public grazing land.
4) High number of cattle present in wolf range, both winter and summer
5) Relatively lower connectivity of wolf population to large adjacent gene pools
6) Cattle depredation is the largest barrier to effective wolf management and conservation
7) High number of stakeholders and a vocal urban public that wants to see wolves in SW Alberta, relative to northern areas
8) Rapidly accelerating land use pressures
9) Relatively higher budgetary requirements because of the detailed knowledge needed to manage a small and controversial population, while still maintaining credibility with a multitude of stakeholders
10) Need for finely detailed biological information in light of finer scale of management required in a heavily settled landscape

It is apparent that if short-term success is to continue, budgets must be ongoing, there must exist a willingness from ranching community to work cooperatively with agency staff, the wolf population must continue to be monitored using collared animals, and improved communication with public and stakeholder groups must be achieved.

Management activities for the current year (2004-2005) include possible extension of collaring to areas where little knowledge exists (Livingstone, Beehive, Front Ranges); in depth GIS examination of satellite collar data in relation to depredations and winter elk/cattle distribution (Appendix 10); continued monitoring of collared packs and population status; evolution of strategy for depredation response, including research into non-lethal methods where appropriate; and, search for funding/research collaborators.

It is apparent that we can achieve success when sufficient funds are dedicated to specific management issues. For wolf management in southwest Alberta, success means: limitation of mortality in packs, especially non-depredating packs, to achieve greater

stability in the wolf population; gathering of key biological information to help management decisions; effective and timely response to livestock conflicts and depredation; engaging stakeholders in communication and cooperation; implementation of effective non-lethal stewardship by ranchers in cooperation with other parties; continued personal communication with local ranchers and landowners; and maintenance of wolf population for economic benefits such as hunting, trapping and non-consumptive use.

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Elizabeth Bradley. Graduate student, University of Montana, September 2003.

Kirk Olchowy, Fish and Wildlife officer, Crowsnest Pass, Alberta. Personal communication, 23 August 2004.

Perry Abramenko, Fish and Wildlife officer, Pincher Creek, Alberta. Personal communication, 9 August 2004.

Richard Quinlan, Species at Risk biologist, Lethbridge, Alberta. Personal communication, 24 August 2004.

Tom Davidson, National Park Warden, Banff, Alberta. Personal communication, 31 August 2004.

Appendix 1. Summary of main regulations for wolf hunting/trapping, affecting population management.

- Residents may, without a licence (but require a WIN card), hunt wolves from the opening of any big game season in a particular WMU (roughly September) until May 31.

- Landowners (or their designates) may shoot wolves within 5 miles of their occupied land (includes lease/allotment) at any time of year.

- Registered trappers may trap number wolves on their traplines from November 1 (December 1 for 2004-2005 season) to February 28. There are no quotas.

These liberal regulations are in place under the general assumption that they will assist in maintaining wolf populations at tolerable levels. No special consideration has been given to specific provincial regions differing in their wolf population sizes or dynamics, although registration of harvested wolves is mandatory in the SW portion of Alberta. It should be noted that recolonization of previously occupied habitat by wolves in SW Alberta occurred with these liberal regulations in place. On the other hand, SW Alberta wolf population continues to fluctuate greatly through time, as packs are commonly destroyed when livestock conflicts increase.

Appendix 2. Oldman Basin Carnivore Advisory Group: **TERMS OF REFERENCE**

Role

This local Advisory Group will be established by the Department of Sustainable Resource Development (SRD), Fish and Wildlife Division, Pincher Creek Area to provide input and advice on the management of large carnivores in the Oldman Basin area. Initial focus will address wolf depredation issues in the Bob Creek area. Advice will be considered in formulating an area strategy for the management of wolves to be approved and endorsed by the Department of Sustainable Resource Development (SRD), Fish and Wildlife Division.

General roles of the advisory group include:

- Promoting cooperation in large carnivore management and conservation
- Providing a means for effective local representation and participation
- Identifying potential carnivore management principles, goals and actions
- Developing and managing a model work plan for the achievement of carnivore management goals (including budgeting and funding support development)
- Reporting to and providing recommendations to the Fish and Wildlife Division, towards creating a local carnivore management framework

Membership and Tenure

Membership of the advisory group will include representatives of Alberta Sustainable Resource Development (Fish and Wildlife Division, Public Lands Division), Alberta Community Development (Parks and Protected Areas), Alberta Beef Producers, MD Ranchlands, Alberta Trappers Association, local ranchers, Federation of Alberta Naturalists, Southern Alberta Conservation Cooperative, the Alberta Wilderness Association and the Blackfoot Confederacy. Other organizations and individuals are encouraged to bring forth representation through standing committee members. Representatives from other SRD divisions may be called upon to provide technical information as required.

The chair (or co-chairs) will initially be appointed by SRD, and sit for a 2-year period. Members will participate in the advisory group for a 2-year period, and be responsible for nominating a replacement in the event that circumstances result in the member leaving the group. Members may have an alternate represent them as required.

Group Members:

1) AB SRD Public Lands Division
2) AB SRD Fish and Wildlife Division
3) MD Ranchlands

4) Blackfoot Confederacy (invited, not participating)
5) Federation of Alberta Naturalists
6) Local Rancher Interests
7) Alberta Trappers Association
8) Alberta Beef Producers
9) Southern Alberta Conservation Cooperative
10) Defenders of Wildlife Canada
11) AB Community Development

Group Procedures

- Group members will strive to create effective recommendations that are agreeable to everyone. A simple majority will not be taken as the basis for a decision. Alternative decision-making strategies such as defining an acceptable level of agreement will be used or disagreements will be clearly presented in the final recommendations.
- Support to the advisory group will be provided by SRD administrative staff. This may include but not be limited to the recording of meeting minutes, meeting facilitation, data distribution and presentation preparation.
- Meetings will be scheduled as necessary at the MD Ranchlands Administrative Office.
- The Chair will hold the right to remove members from the group if necessary to allow the group to make progress on resolution of issues.

Reporting

The Advisory Group will make recommendations to the Fish and Wildlife Division on a regular basis. Direction to the Advisory Group will come from the Fish and Wildlife Division.

Travel Expenses
All travel expenses incurred by members of the Advisory Group will be reimbursed by the Alberta Government. To claim expenses, any member must document the expenses incurred. Eligible expenses include: personal vehicle use ($0.38/km), communications and incidentals or materials related to each formal meeting. Receipts are required; expenses may be submitted at each meeting.

Appendix 3. Summary of issues raised by member groups at Oldman Basin Carnivore Advisory Group meetings.

#	Issues	Known Information	Needed Information	Suggested by	Meeting
1	Compensation for losses to predators is not complete	not all cattle kills get reported and injuries and harassment contribute to financial loss; time to process	quantify extent of unreported losses; extent of financial loss as a result of non-lethal injury and harassment	MD Ranchlands	Jun, 2003
2	Can depredation be stopped by removing individual wolves from depredating packs?	research is contradictory and inconclusive; likely depends on social structure	test idea of targeting individuals to stop depredation, versus removal of whole packs	FAN	Jun, 2003
3	Cattle social structure may influence vulnerability of individuals	some cows are more aggressive in defending their calves	Behavioural studies focussing on wolf interaction and cattle behaviour	ABP	Jun, 2003
4	Some age/sex classes of cattle appear more vulnerable to predation	yearlings appear more vulnerable to depredation due to lack of vigilance, curiosity, range use, lack of aggression	landscape comparison of what cattle are available versus what cattle are killed by wolves (determine if pattern is non-random)	MD Ranchlands	Jun, 2003
5	Depredation does not occur evenly across the landscape	info by SACC and F&W based on confirmed reports of kills and injuries; recent research has focussed on predictors of depredation hotspots (Muhly et al. 2003)	analysis of why these "hotspots" exist; contributing factors	ATA	Jun, 2003
6	preventative/non-lethal tools/methods are needed to prevent depredation	Some success with guardian dogs to protect sheep	obtain funding for more extensive experiments, and compensation for those negatively affected during experimentation	ABP	Jun, 2003
7	poor understanding of local wolf demography	very little	population size, home ranges, birth/death/immigration rates...	FAN/ABP	Jun, 2003
8	lack of funding	funding is unstable, and varies over time leading to lack of consistent long-term approach	how to secure funding over time; define a reasonable budget	ABP	Jun, 2003

#	Issues	Known Information	Needed Information	Suggested by	Meeting
9	F&W response to depredations has been ineffective, slow	toxicants are best employed only in winter, may not be selective or humane; lack of resources to trap; selective shooting from air not permissible	animal care evaluation of humane methods; research other jurisdictions	MD Ranchlands	Jul, 2003
10	need management plan in place to define course of effective action when depredations occur	currently only dated provincial plan in place - not policy	Relevant local strategy	MD Ranchlands	Jul, 2003
11	need increased range riding and attention to timing of grazing in certain pastures to prevent depredation from starting	economically difficult for ranchers to implement	cost transfer from consumers/conservationists	SACC	Jul, 2003
12	need to identify what acceptable levels of loss are for ranchers	zero losses is not a reasonable short-term goal	size of operations experiencing conflict; full economic impact study	ABP/DWC/Ranchers	Jul, 2003
13	need results to maintain landowner support		better communication to public	MD Ranchlands	Jul, 2003
14	education/information for hunters to avoid shooting collared wolves, when possible		need to work with Fish and Game clubs; make collars more visible	DWC	Oct, 2003
15	how can NGO's effectively collaborate in cooperation with local management initiatives		Improved communication and understanding of mutual objectives/constraints	DWC	Oct, 2003
16	need collars/info on other packs not killing cattle	no current info on non-cattle killing wolf packs in SW Alberta	More collaring effort	MD Ranchlands/ABP	Oct, 2003
17	need mechanism to distribute $ from urban segment that desires wolves to rural segment that deals with the financial loss of having wolves	no mechanism exists		ABP/DWC/Ranchers	Oct, 2003
18	need to involve hunting community in consultation/committee			FAN/MD Ranchlands/SACC	Oct, 2003

#	Issues	Known Information	Needed Information	Suggested by	Meeting
19	may need to micro-manage packs		dedicated staff solely for wolf management	ABP	Oct, 2003
20	ranchers need to understand the wolf management goals			SACC	Oct, 2003
21	ranchers need strong incentives	Some success in US northern Rockies (Stone et al. 2003)	Source/type of incentives needs definition	DWC	Oct, 2003
22	public needs to understand wolf management goals and techniques		Better communication from managing agencies	FAN	Oct, 2003
23	trappers suffer loss of fur when control work is done		Evaluate losses and examine alternatives such as collaborative live trapping	ATA	Oct, 2003
24	difficult to do research on depredation when data not freely available		Better and transparent communication required	SACC/DWC	Nov, 2003
25	grizzlies may exacerbate cattle depredation by wolves	Many wolf kills/injuries are taken over by grizzly bears – may exacerbate depredation, but bears are only filling their ecological role	Better compensation	SACC	Nov, 2003
26	need better communication between committee members and groups they are representing			SACC/DWC	Nov, 2003
27	how does Group ensure recommendations are heard/effective		Clear route of communication to government agency	SACC	Nov, 2003
28	need newsletter for communication	Communication needs to be clear to avoid negative response to wolves		SACC	Nov, 2003
29	need to define thresholds for control work and stepped actions	Can't expect depredation to be zero	Scale of current losses on a producer basis with compensation included	DWC	Jan, 2004
30	how do we deal with problems before committee finalizes management strategy recommendations	Informal feedback has been successfully incorporated into agency decision making	Interim plans	ABP	Jan, 2004

Appendix 4. Description of incremental lethal control.

In contrast to non-incremental control in which a whole pack is killed in a case of "chronic" depredation, incremental lethal control involves removing only a few members of the pack at a time, with the goal being to reduce depredation rates to something considered tolerable (Fontaine, personal communication). For large packs (e.g. 10+), the first removal will be larger than for smaller packs (9 or less). Numbers removed may depend on pack composition when known (numbers of pups, subordinate adults, breeding adults). The ultimate goal in choosing incremental lethal control over non-incremental actions is to maintain wolf distribution over current range. Should one removal not achieve the desired goal, subsequent removals will occur, to the point that the pack may be eliminated should the depredation continue at an undesirable level. The definition of what is tolerable is key to the extent to which this method can be used.

Appendix 5. A summary of non-lethal methods for deterring wolf depredation.

Method	Research and Testing	Local examples	Mode of operation
Radio-activated/motion-activated guard boxes (RAG / MAG boxes)	Shivik et al. 2003	None	Radio signals from collared wolf or animal movement activates scare devices consisting of pre-recorded sounds/lights
Putting selected age/sex classes of livestock in areas prone to depredation		Implemented by actively by some local ranchers; idea needs to be tested.	When an area is known to be subject to depredation, the running of cow-calf pairs may reduce depredations. Some believe yearlings are more vulnerable to depredation.
Running longhorn steers with yearlings		Often done for other reasons not related to depredation (they act as leaders for yearlings)	May provide protection from wolves
Moving cattle away from areas of depredation (spatially or temporally)	"Buffalo Ridge" Defenders' US project near Clayton, Idaho		Hold cattle in areas away from high risk zones, or graze high risk areas only during low risk periods of the year
Fladry	SACC 2001; Musiani et al. 2003	Experiments by SACC (Marco Musiani, Charles Mamo)	Suspended lines of flags close to the ground deter wolves from crossing into protected areas.
Radio-activated shock collars	US research	None	Electrical shocks are administered to wolves that approach marked livestock
Guard animals (dogs, llamas, donkeys)	Coppinger 2003	Not considered practical in open range scenarios with large numbers of dispersed cattle; has worked for some sheep ranchers	Dogs may chase off predators, or bring livestock to a safe area.
Harassment/night riders/monitors	US Fish and Wildlife Service 2004; Defenders (US) with Wild Horse wolf pack (2002)	Needs further testing	Individuals assigned to monitor/deter presence of radio collared wolves in cattle herds prone to depredation
Removal of carcases		Local rancher removes carcases so wolves won't be attracted to his	May reduce contact rates between wolves and livestock

		rangelands.	
Removal of sick or injured cattle from area of risk		Some local examples of ill or injured livestock being taken by wolves	Predators key on slow and lingering prey (old, sick, injured). What roles do sick or injured cattle play in depredation? In initiating depredation episodes?
Retaining horns on cows			Are horned cattle more likely to discourage depredation? Added cost at slaughter houses.
Investigate the role of learned "familiarity" of cattle with rougher public land and predators		Ranchers have observed different behaviour of cattle familiar with mountain pastures compared with those accustomed only to "tame prairie" pastures	Could cattle familiarity with mountain terrain (and, perhaps, with predators) be exploited to deter depredation?
Types of herding techniques		One stock manager applies what he can from the Williams' methods with client herds	Some techniques encourage herding behaviour by cattle; others discourage it (see, for example, Bud Williams Stockmanship Schools). Can cows be encouraged to herd together more? Would this discourage depredation?
Calving sheds/areas		Rancher often calve heifers in special areas so calves aren't as vulnerable to wolves and other predators	Heifers calving in random locations on rangeland likely are more vulnerable to depredation.
Remove cattle from wolf territories during winter		One local pack that has not preyed on livestock during the study period does not contain cattle in its winter range	How much does leaving cattle on winter range "encourage" year-round depredation?
Provide telemetry gear to ranchers/operators	Carried out by US Fish and Wildlife in Montana	3 livestock producers provided receivers in 2004	Allow operators to detect wolf presence when collars are deployed in resident packs

Appendix 6. Budgets allocated by SRD Fish and Wildlife Division and collaborators for wolf management in SW Alberta. SRD budget was reduced by $10 000 in second year due to increased operating expenses of the Division.

I. TOTAL SRD WOLF BUDGET (April 2003 - March 2004): $40 000.00

Expense	Amount
Contract for live capture/collaring/monitoring (August)	$6,600.00
Contract for wolf removal (September)	$2,100.00
Satellite telephone	$540.00
Gas expenses	$500.00
Advisory Group meetings	$1,530.00
Enforcement operational expenses (conference, vehicles, travel, meals)	$1,730.00
Satellite collars	$10,000.00
Contract for trapping collaboration	$5,000.00
Aerial capture for satellite collar deployment	$10,000.00
Monitoring	$2,000.00
TOTAL	**$40 000.00**

Additional monies/Collaborative work (April 2003 – March 2004):

Alberta Beef Producers/Defenders of Wildlife Canada ($13 000)
Community Development: telemetry equipment and helicopter flights ($9000); lodging
Ranchers: voluntary participation in wolf monitoring
C. Mamo: voluntary time and vehicle expense
AB SRD (Fish and Wildlife Division): use of vehicle, quad and satellite phone

II. TOTAL SRD WOLF BUDGET (April 2004 - March 2005): $30 000.00

Expense	Amount
Live capture/collaring/monitoring (August-September)	$6,000.00
Advisory Group meetings	$5,000.00
Satellite collars (3)	$8,000.00
Aerial capture for satellite collar deployment	$5,000.00
Held for future work	$6,000.00
TOTAL	**$30 000.00**

Additional monies/Collaborative work (April 2004 – March 2005):

Alberta Beef Producers ($10 000)
Defenders of Wildlife Canada ($5 000)
Community Development: in kind staff and equipment; lodging
Ranchers: participation in wolf monitoring
C. Mamo: 5 days labour and vehicle

Appendix 7. Ground monitoring of collared wolves in Willow Creek pack (C. Mamo), September – November, 2003.

Date (2003)	Time of day	Wolf ID	Estimated Location (UTM)	Locational Error (m)
Aug-29		77,78,80	0685800 5573400	100
Sep-04		78,79,80	0685000 5580000	1000
Sep-04	1500	78,79,80	0685000 5580000	1000
Sep-05	1500	77,78,79,80	0685300 5558200	100
Sep-09		77	0685900 5579900	100
Sep-10	1210	78	0685900 5578400	100
		79	0686200 5577500	100
		80,77	0686200 5577500	100
	2005	77,80	0686200 5577500	100
Sep-11	1830	78,79,80	0686000 5577550	100
		77	0686100 5577400	100
Sep-12	1400	77,78,79	0686000 5577550	100
Sep-15	1600	78,79	Gen. Shepard Ck	N/A
	1900	78	0686400 5576900	100
Sep-16	2215	77,78,79,80	0685900 5578400	100
Sep-17		77,79	0686200 5576600	100
Sep-18		77,78,79,80	0686300 5576400	100
Sep-19	1530	77,78,79,80	0686200 5576800	100
Sep-20	800	77,78,80	0686300 5576800	100
	1010	79	0686000 5576600	100
Sep-21	1600-2010	77,78,79,80	0686300 5576800	100
Sep-27	1500	77,78,79,80	691200 5577500	100
Sep-29	1600	78	0686300 5576800	100
	1630	79	0687000 5579100	100
	1930	77,80	0686400 5577000	100
	2035	79	0688200 5577100	100
Sep-30	700	80	0690800 5578000	shot
Oct-02		78,79,80	0692104 5581561	
Oct-03		77,78,79	0692104 5581561	
Oct-04		78	686200 5576700	100
Oct-06		78	0686100 5576700	100
Oct-06	1400	79	0684300 5575600	100
	1700	79	0684300 5575600	100
	1805	78	0686100 5576700	100
Oct-07	1810	79	0684600 5577300	100
		78	0687700 5578700	100
Oct-08		77,78	0686200 5576700	100
	1410	79	0685200 5576500	100
	1615	77,78,79	0685200 5576500	100
	1800	77,78	0686200 5576700	100
Oct-09	1520	77,78	0686000 5576700	100
Oct-10		77,78	0686000 5576700	100
Oct-21		77,78,79	0686200 5572000	100
Oct-24	1140	77,78,79	0684200 5575300	100
	2100	77,78,79	0684350 5575400	100

Date (2003)	Time of day	Wolf ID	Estimated Location (UTM)	Locational Error (m)
Oct-25	0730 am	77,78,79	0684350 5575400	100
	1040			no signal
Oct-26	1120	77	0686100 5570300	100
Oct-31		77,78,79	0680572 5584723	100
Nov-07		77	0686900 5580300	100
		78	0686200 5580700	100
Nov-09		78,79	0685300 5575800	100
Nov-10		79	0682900 5577500	100
		77	0685500 5574300	100
Nov-11	1515	79	0683100 5577000	100
Nov-12		78	0686000 5576700	100
Nov-26		78	0687700 5574200	100

Appendix 8. COWS radio receiver loan protocol.

Background

In an effort to explore proactive techniques to prevent livestock predation by wolves, it has been suggested that producers have the opportunity to use radio telemetry equipment to detect the presence of wolves near cattle that may be at risk of wolf predation. Such knowledge allows producers to take proactive and non-lethal measures to prevent cattle depredation. This technique has been utilized extensively by the US Fish and Wildlife Service in Montana as part of their strategy to help minimize livestock depredation by wolves. This agency has ~15 telemetry receivers that are given out judiciously to producers with an agreement as to how they will be used.

Conditions under which receivers may be loaned

- To producers who agree that a change in how Albertan's manage wolves is required and that the ranching community is a vital part of this process
- To producers with a history of livestock depredation in areas where we have active wolf activity (as shown by satellite or ground telemetry)
- To producers who possess cattle that may be at risk of wolf predation due to their presence in areas of active wolf activity (as shown by satellite or ground telemetry)

Conditions of equipment loan

- District officer and area biologist to be informed and consulted before any equipment is loaned out.
- Serial number of receiver and complete list of items loaned to be maintained by person loaning equipment. This person will be responsible for retrieval of equipment.
- Only frequencies of wolves whose territories overlap producer pastures/allotments/leases will be given out (ensure all other frequencies are deleted from the receiver)
- The producer must agree to relinquish these frequencies when the equipment is returned.
- The producer must agree not to provide the frequencies to those not directly involved with the management of the cattle at risk, and all persons assisting must abide by the full agreement.
- The producer must relinquish the equipment when requested to do so.
- Breakage/damage is cost of doing business unless we can show that the damage was caused by neglect or intentional.
- The producer must not use the equipment to follow wolves on the ground unless implementing a proactive action agreed to by Fish and Wildlife staff.
- The producer may shoot wolves that are located with the equipment ONLY if they are in the act of killing livestock, or if they are individuals that have been identified by F&W for removal, with preference being given to the shooting of non-collared individuals.

- The producer will use the equipment with the intent of determining the proximity of the wolves to cattle that may be at risk
- The producer will be encouraged to use information that wolves are in proximity to cattle to harass wolves with bangers, rubber bullets, bean bags and an increased presence on the landscape during times which wolves normally hunt, ie night time.(We can't provide rubber bullets or bean bags due to federal legislation. They can purchase them from Margo's if licenced out of High River. Montana agencies gives all these out to producers – have stories of ranchers hitting wolves with rubber bullets/bean bags and wolves never returning again.)
- The producer will sign a written agreement outlining the conditions of equipment provision.
- The producer will be instructed in correct use of the equipment (only instruct on scan and memory options of receiver, not programming).
- We need to identify den sites when possible so that the producer does not constantly harass wolves when they are near to the actual site. This may cause the wolves to leave the den which may make summer capture if warranted/wanted more difficult (only an issue from April to August).
- Should provide a simple log sheet which the producer can fill in to find out if proactive measures are valid or a waste of time and money. (Alberta perspective)

Appendix 9. The Economics and Effectiveness of Nightriding as a Preventative Measure to Wolf Depredation: an experiment

Introduction

Three wolves in the Bob Creek pack were collared in February 2004. Movements were subsequently monitored, and no livestock depredations by this pack were recorded in the winter months. The third week in March, the pack moved eastwards into the Porcupine Hills, and was implicated in the death of two cattle owned by two different producers. On 1 April 2004, approximately 1250 yearling cattle were moved into a grazing allotment in the center of the known wolf territory, as part of a dormant season grazing strategy.

Through the first three weeks in April, 7 of these cattle were killed or severely injured by the Bob Creek pack, and an additional yearling on the eastern fringe of the territory was also critically injured. These cattle were monitored and checked during daylight hours for all but a few days of their tenure on the allotment. Telemetry gear was given to the rider to help in determining the presence of the wolves.

On a least six evenings prior to sunset, an additional check was conducted by the rider, and shots fired in the assumed vicinity of the wolves. In at least two of these cases, the wolves appeared to have moved northwards, following the shooting, and remained there for 1-3 days before returning to the vicinity of the cattle in the grazing allotment.

In response to the continued depredation, the alpha male wolf (collared 20 March) was removed from the pack by agency staff on 19 April. The group of 1250 yearlings is scheduled to be moved out of the allotment where the depredation occurred, to nearby leased land on 24 April.

From the Argos telemetry data, and as seen in other areas, wolf activity and movements appear to happen primarily at night. Although the exact timing of the cattle depredations is not known, it would appear that such activity also happens almost exclusively between dusk and dawn.

Objectives

To test whether human presence combined with the ability to detect wolf presence through radio telemetry is effective in deterring or decreasing depredation rates of cattle, during hours of darkness (can a "nightrider" be effective?).

To examine the economics of "nightriding" as one of a suite of proactive measures intended to minimize wolf-cattle conflict.

Methods

- To minimize the confounding influences of cattle being removed to a nearby pasture, as well as the removal of the alpha male wolf, a control period will occur during which depredation will be monitored (for comparison of depredation rates

before and after presence of a nightrider). If no further depredation occurs in the control period, then the experiment will be postponed to a future time, as no comparisons can be made.

- The control period will last 3 weeks, or will be terminated sooner if three confirmed depredations by the Bob Creek pack (in the herd of 1250) occur.

- The experimental period will last a similar duration as the control period, or three weeks, whichever is longer. The experimental period will be terminated sooner if three depredations occur after it begins.

- During the experimental period one individual will be employed to camp in the vicinity of the cattle at risk of depredation. Hourly telemetry checks will be conducted between the hours of 8pm and 8am. Should the wolves be detected in the area, shots will be fired in the direction of the wolves (without intent to injure), and harassment continued until it is determined that the wolves have moved away.

- Day monitoring of cattle will continue as in the control period (with records kept of timing and frequency of checks – to be correlated with any known depredation and wolf activity).

- Compensation for cattle lost to confirmed depredation by the Bob Creek wolf pack during the control and experimental periods will be increased to fall market value, to be determined when the remaining cattle are sold to market, with an average value being applied to each individual lost. Budget: to a maximum of 6 cattle, with partial compensation through the existing program, and additional compensation to level defined above paid out of wolf management budget.

Appendix 10. Winter Distribution of Wolves, Elk and Cattle in Southwestern Alberta: a brief project description.

Time frame of data collection: January through March 2004

Wolf territories: Bob Creek and Willow Creek packs

Objective:

- to examine the relationship between wolf movements and space use and the winter distribution of elk and cattle
- to examine the relationship between wolf movements and distribution of dead livestock

Needed information:

- GPS location of field where cattle held
- Verbal description of location of field
- Size of field
- Number of cattle in field
- Age of cattle in field
- # dead livestock
- Method of disposal (if any)
- Time of calving